

Design study on the single-bunch thermionic RF gun

문 성익, 박 성주*, 고 인수, 조 무현, 남 공원

Physics Dept. Pohang University of Science and Technology

* Pohang Accelerator Laboratory, Pohang University of Science and Technology

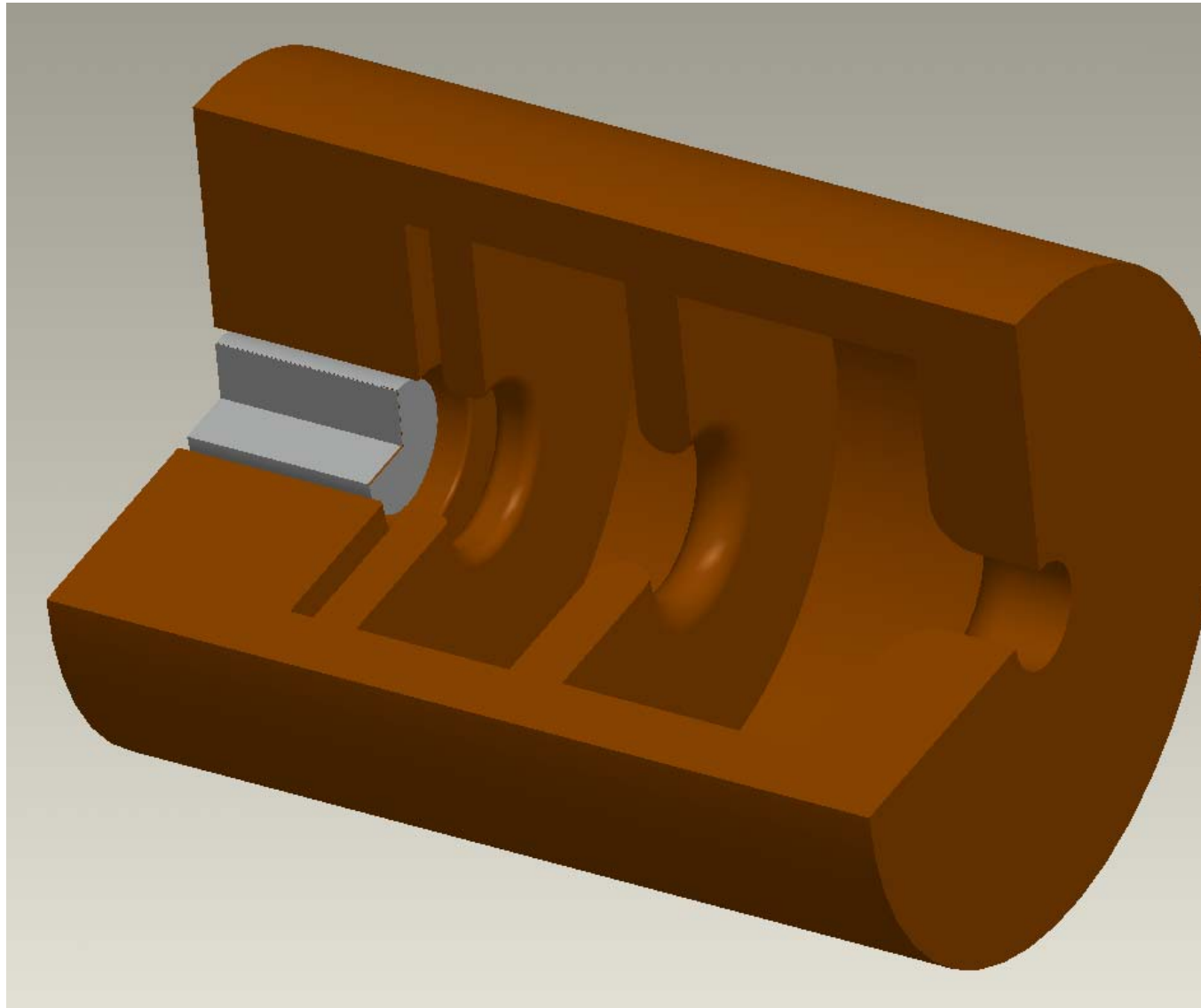
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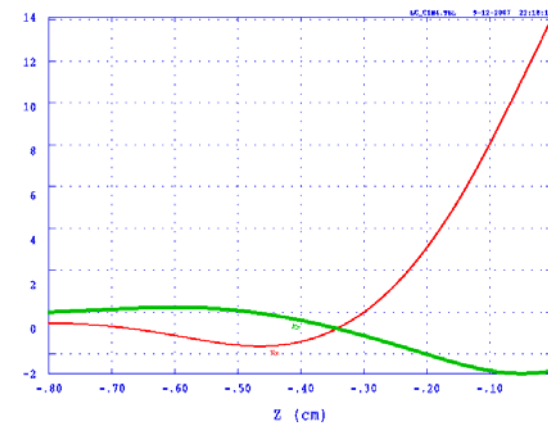
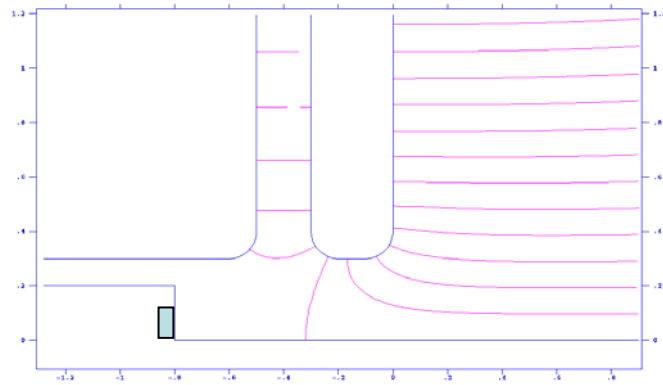
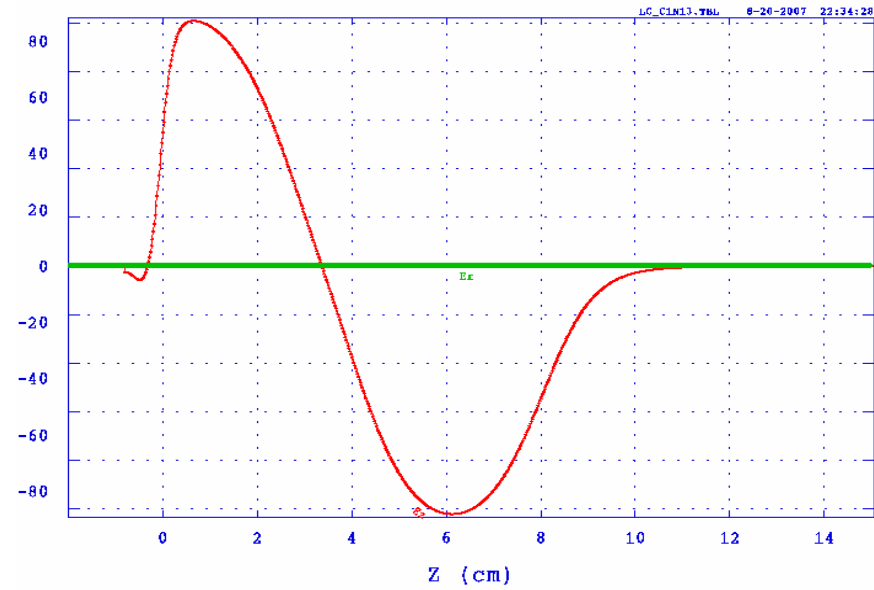
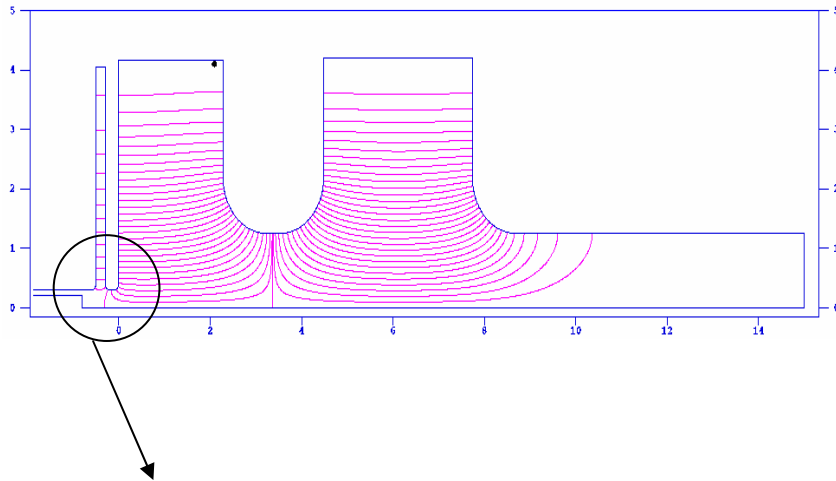
A 1.5 cell thermionic rf cavity with a thermionic cathode on its inner rod has been designed in order to minimize the inherent back-bombardment of electrons onto the cathode. By using a cathode cell and coupler, the electric field at cathode cell can be controlled. Single bunch electron beam can extract by applying bias voltage at cathode. Dependence of the back bombardment power and the output beam properties on electric field at cathode cell and cathode bias voltage have been studied using a 2-dimensional simulation code. Significant reduction of back-bombardment power up to 90% is shown. The transverse emittance degradation is reasonably acceptable.

- **Top-up mode**
 - In normal or in top-up mode, the storage ring is filled with few buckets.
 - Some times-resolved experiments require a constant charge in a single isolated bucket.
 - For stable injection, the beam have to chop.
 - At the SPEAR3, only 3 bunches are allowed by the chopper to enter the linac for further acceleration for injection to the Booster synchrotron.
- **Pump/probe technique**
 - The phenomena's that take place in a very short time intervals, such as electron-phonon scattering , chemical reactions and photo dissociations .
 - the idea of pump-probe technique is using pulses to generate two synchronized trains of pulses one of them used as a pump which is responsible for starting the phenomena and the other is the probe who is responsible for observing

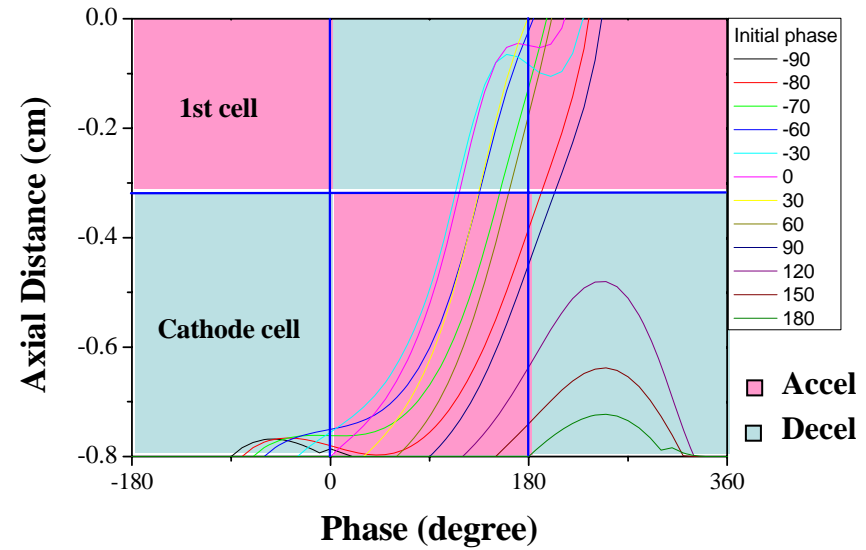
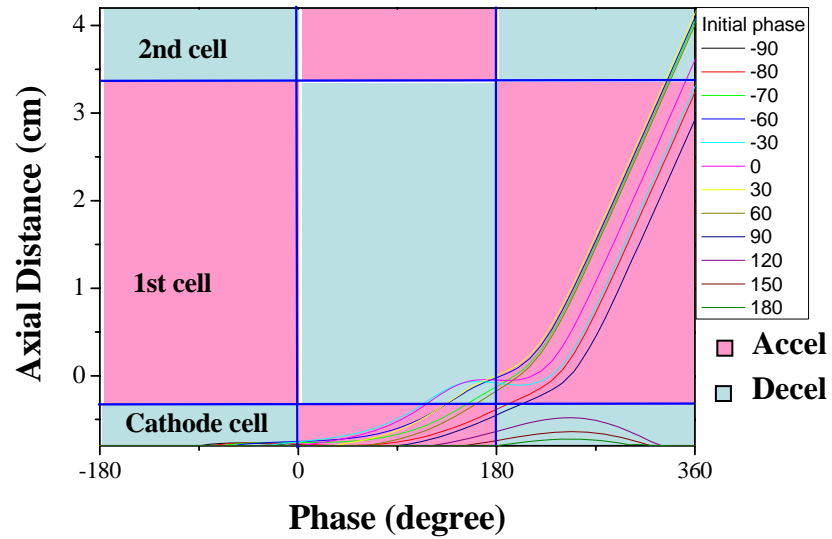
Layout of New designed Thermionic RF gun



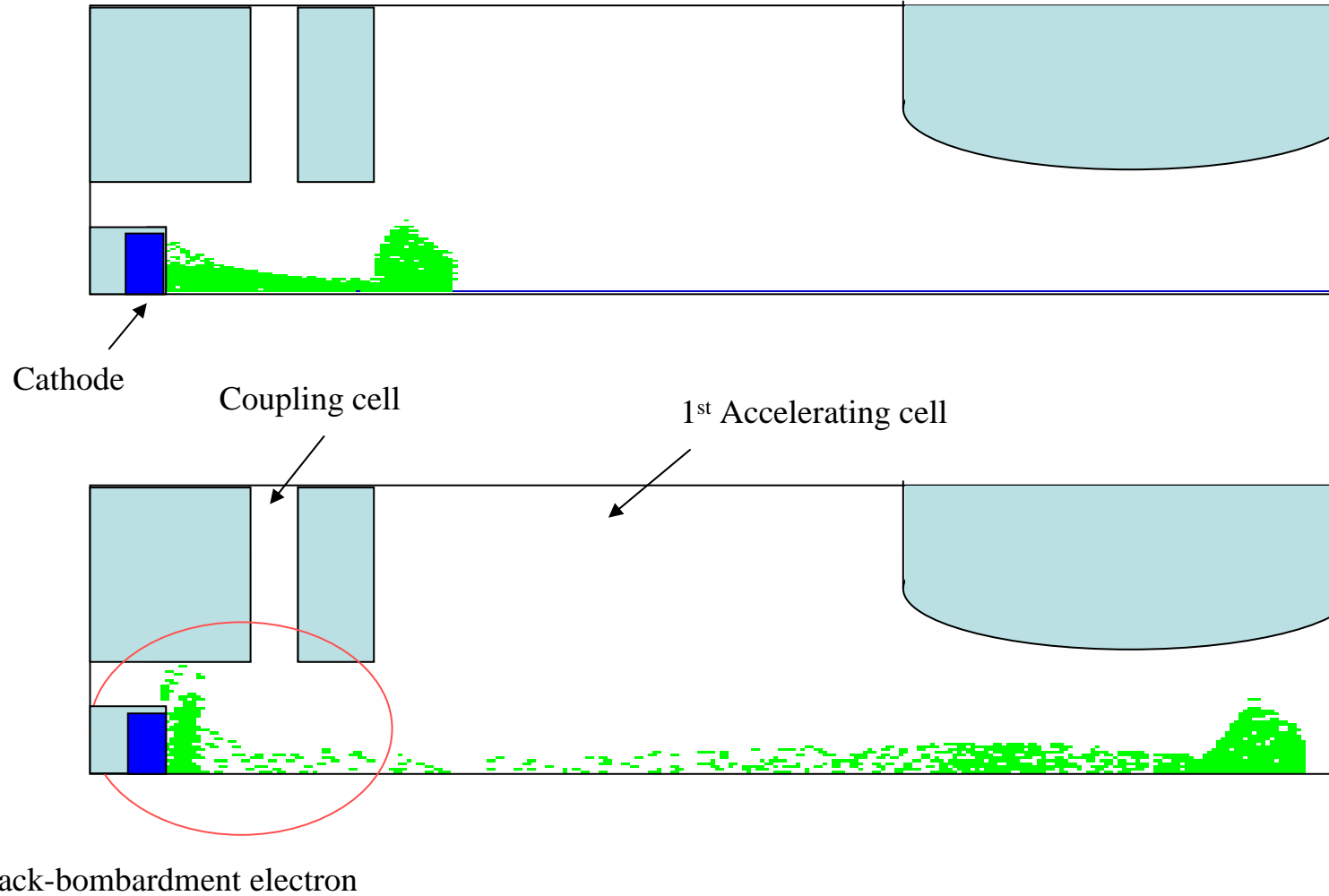
Field on Cavity



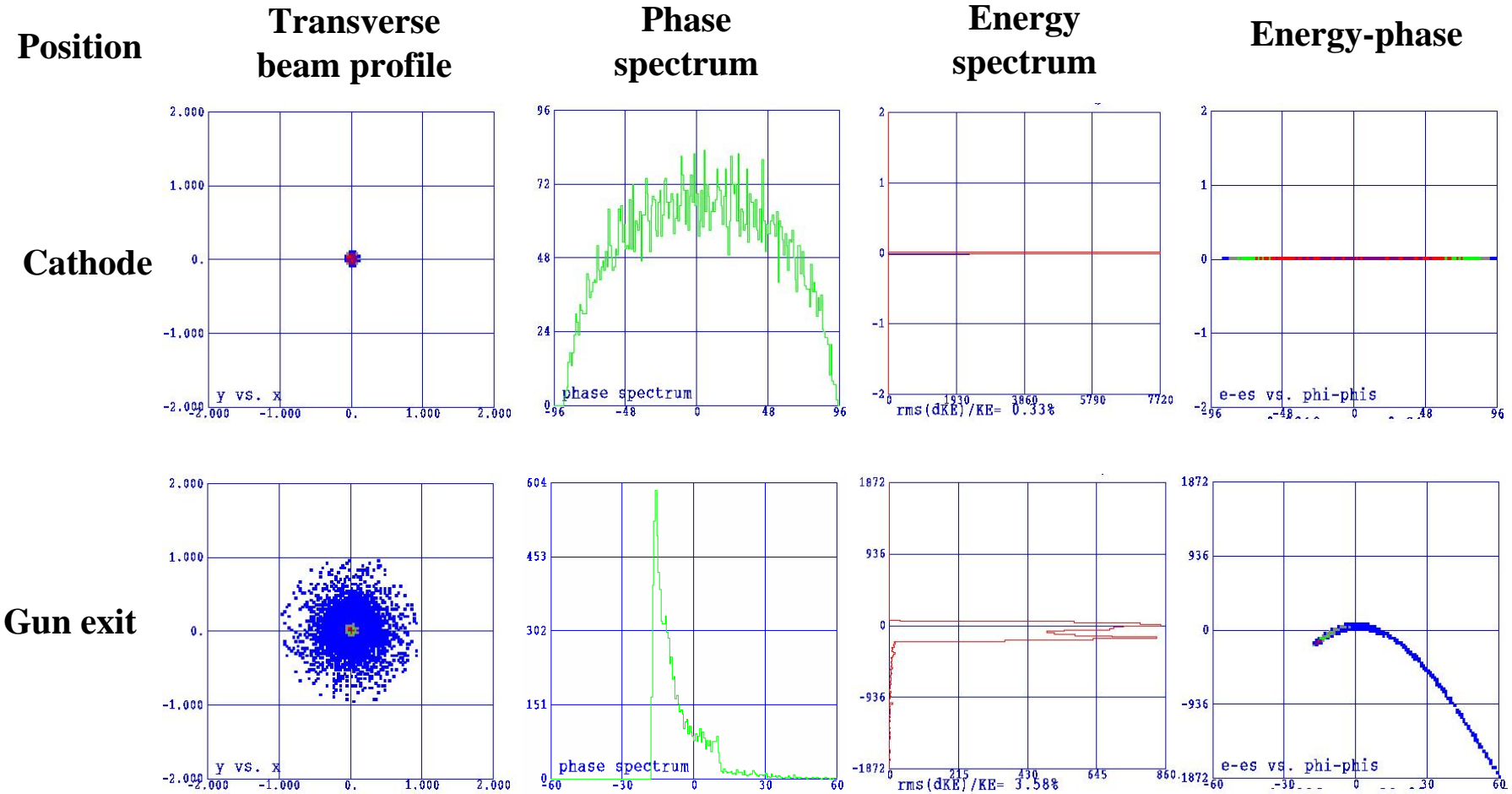
Particle trajectory at different phase



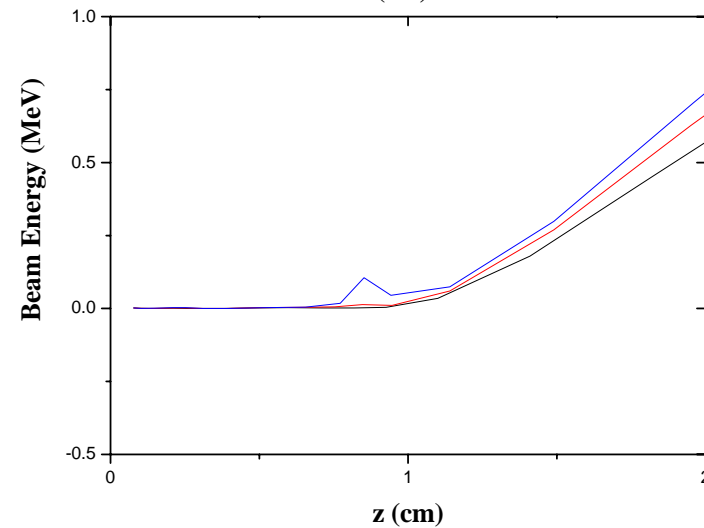
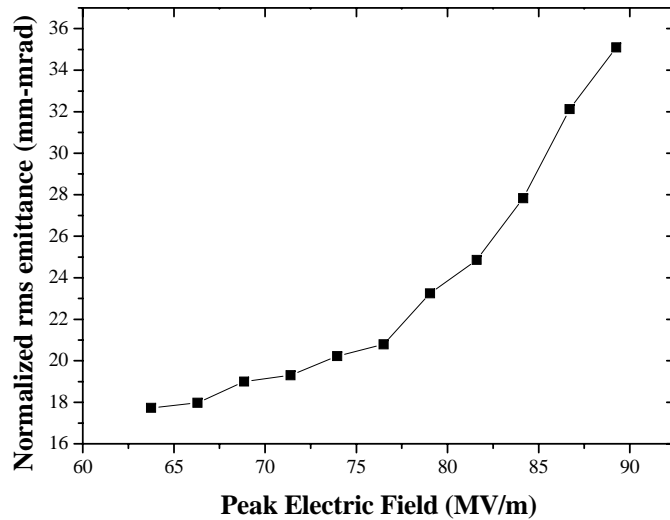
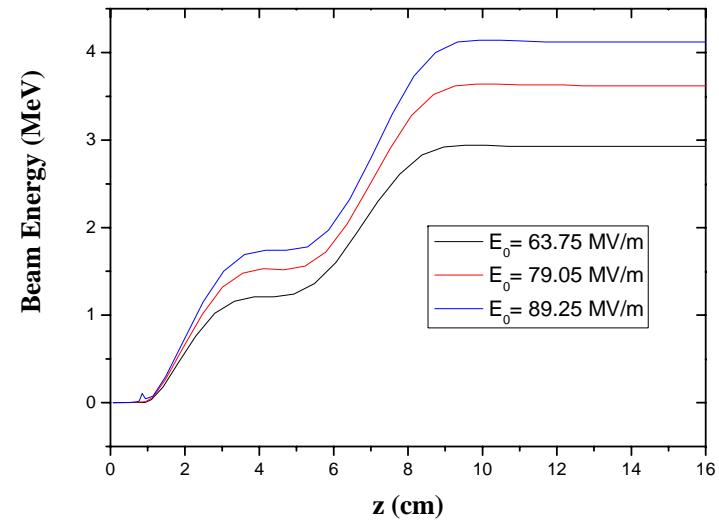
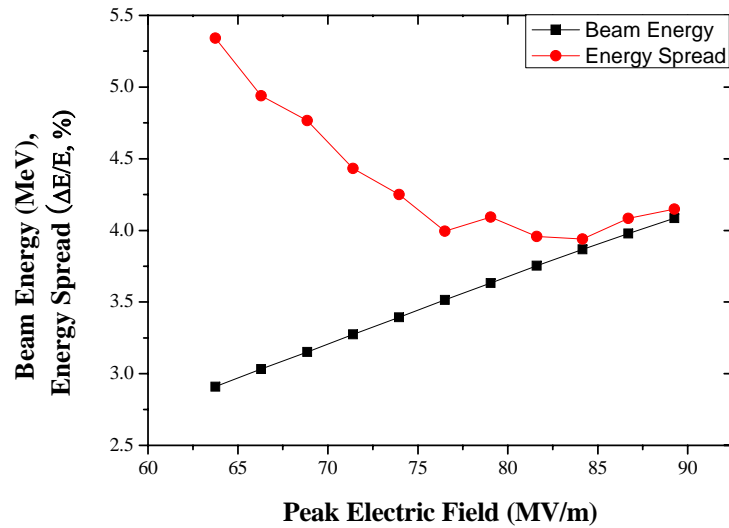
Electron Distributions



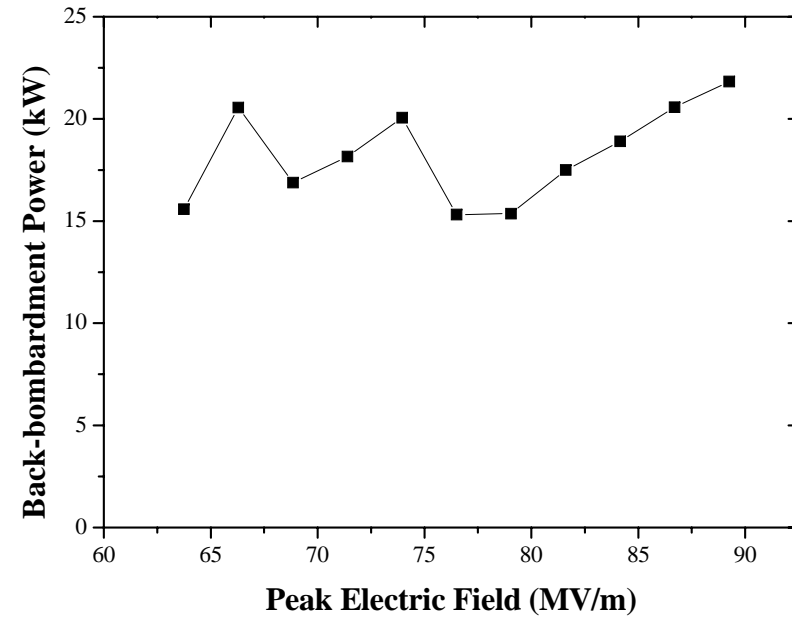
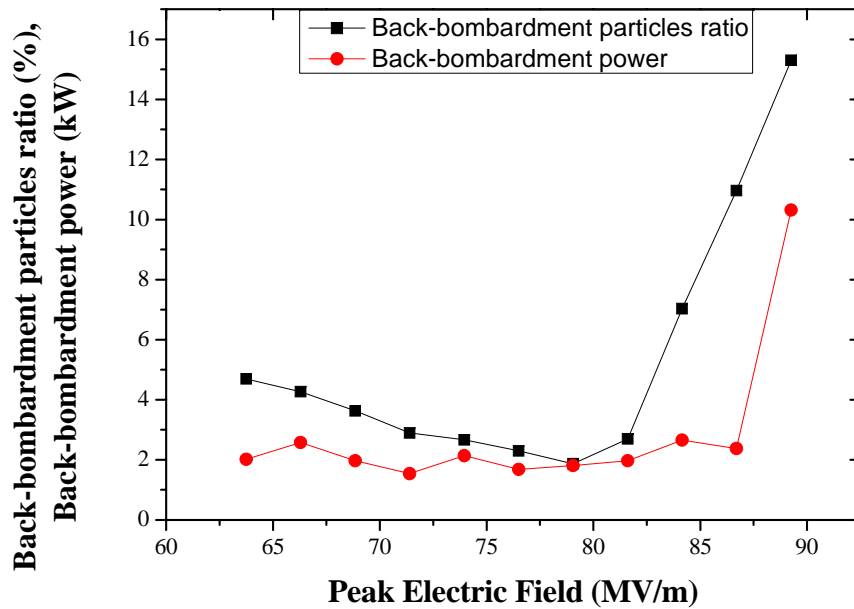
Beam properties (1)



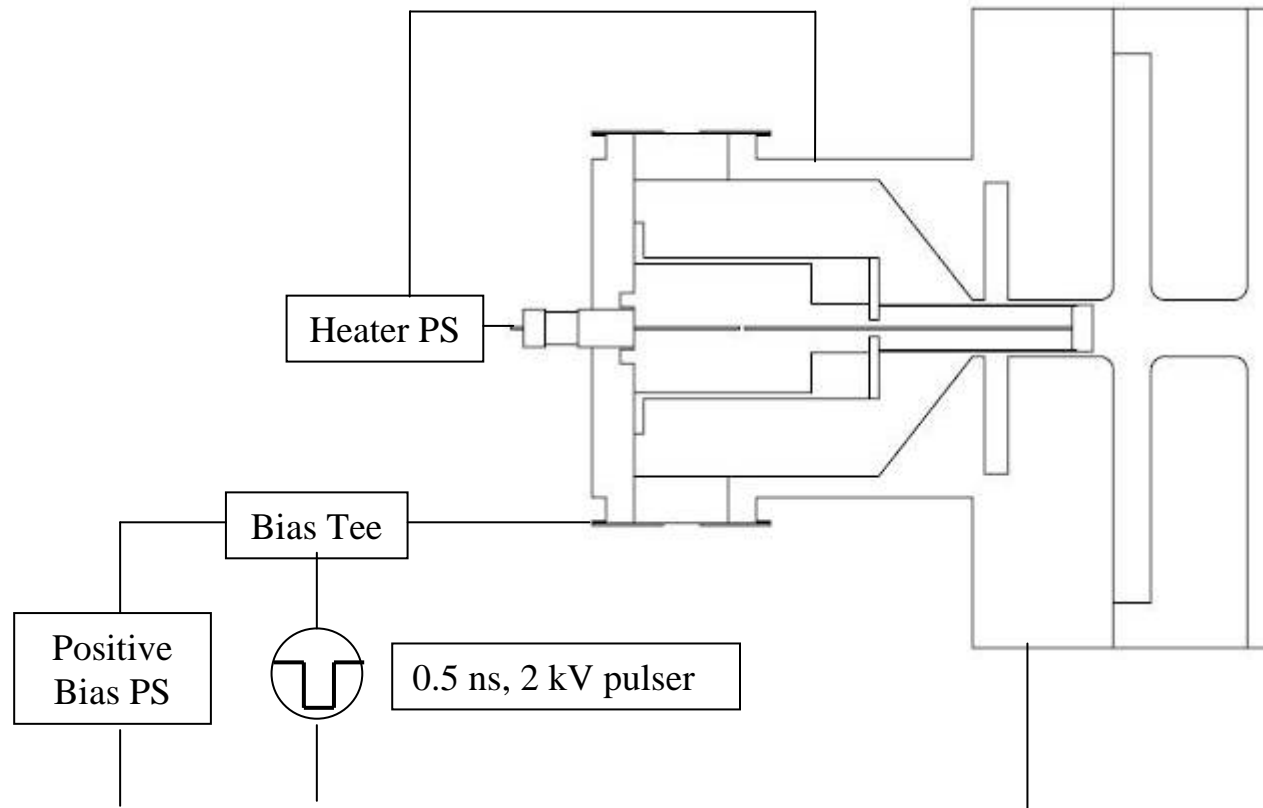
Dependence of Beam Properties on Field strength



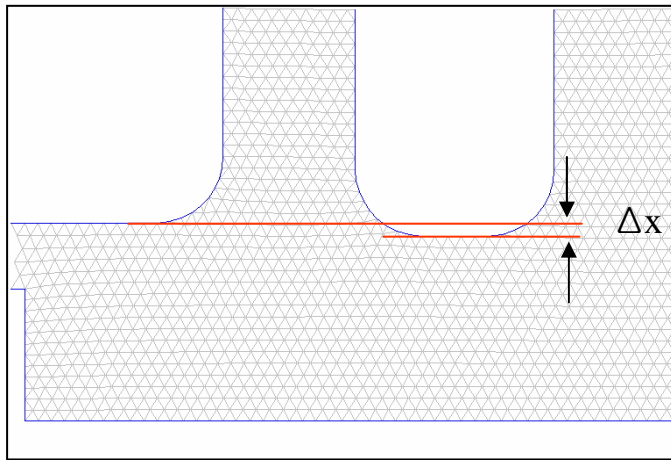
Back-bombardment power



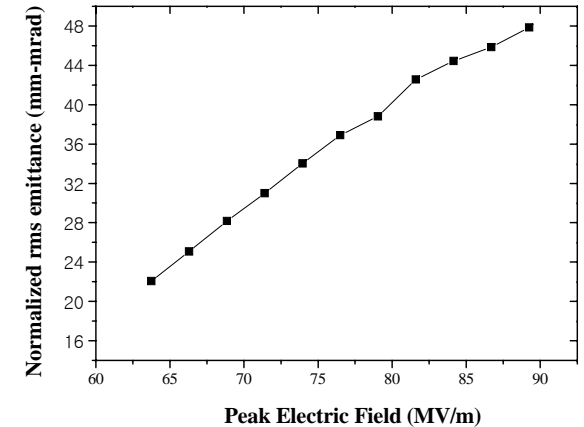
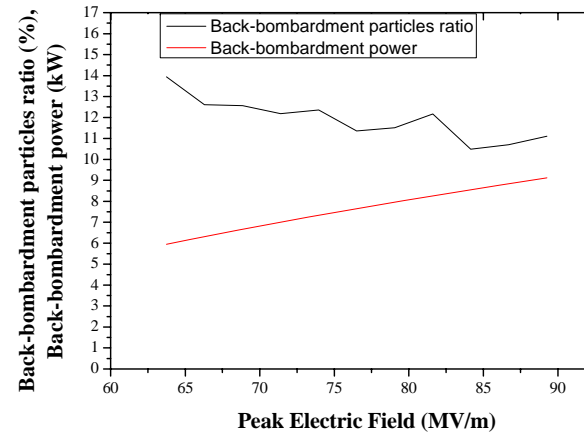
Single-bunch selection with 0.5 ns pulse



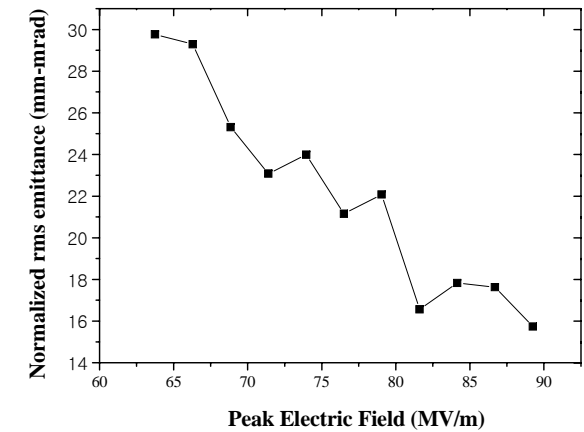
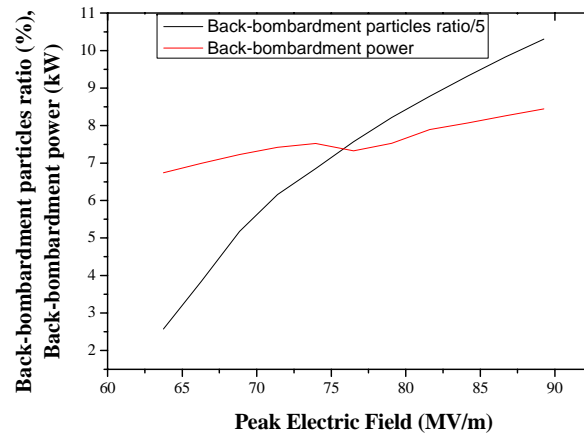
Cathode cavity shape modification



Smaller opening ($\Delta x < 0$)



Larger opening ($\Delta x < 0$)



Beam properties at the gun exit



At the gun exit	
Bunch charge	50 pC
Peak current	2.0A
Beam energy	3.6 MeV
Beam energy spread	3.6%
Normalized rms emittance,	15 π mm-mrad
Back-bombardment ratio	1.9%
Back-bombardment power	4.1 kW

- **The single bunch beam extraction is possible using 0.5 ns pulse.**
- **The result of present design shows significant reductions of the back-bombardment power.**
- **There is emittance degradation because of radial electric field at cathode cell.**